

NATIONAL SCIENCE FOUNDATION
LTER NETWORK
LONG TERM ECOLOGICAL RESEARCH

Greater than the sum of the parts: collaboration in the U.S. LTER Network

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You Cheng, University of California-Santa Barbara

LTER Network Background

Collaboration in LTER-related papers

- Individual
- Institution
- Duration
- Distance

Cross-site Collaboration

- Site Age
- Ecosystem type
- Evolution of inter-site sub-communities
- Factors related to cohesion

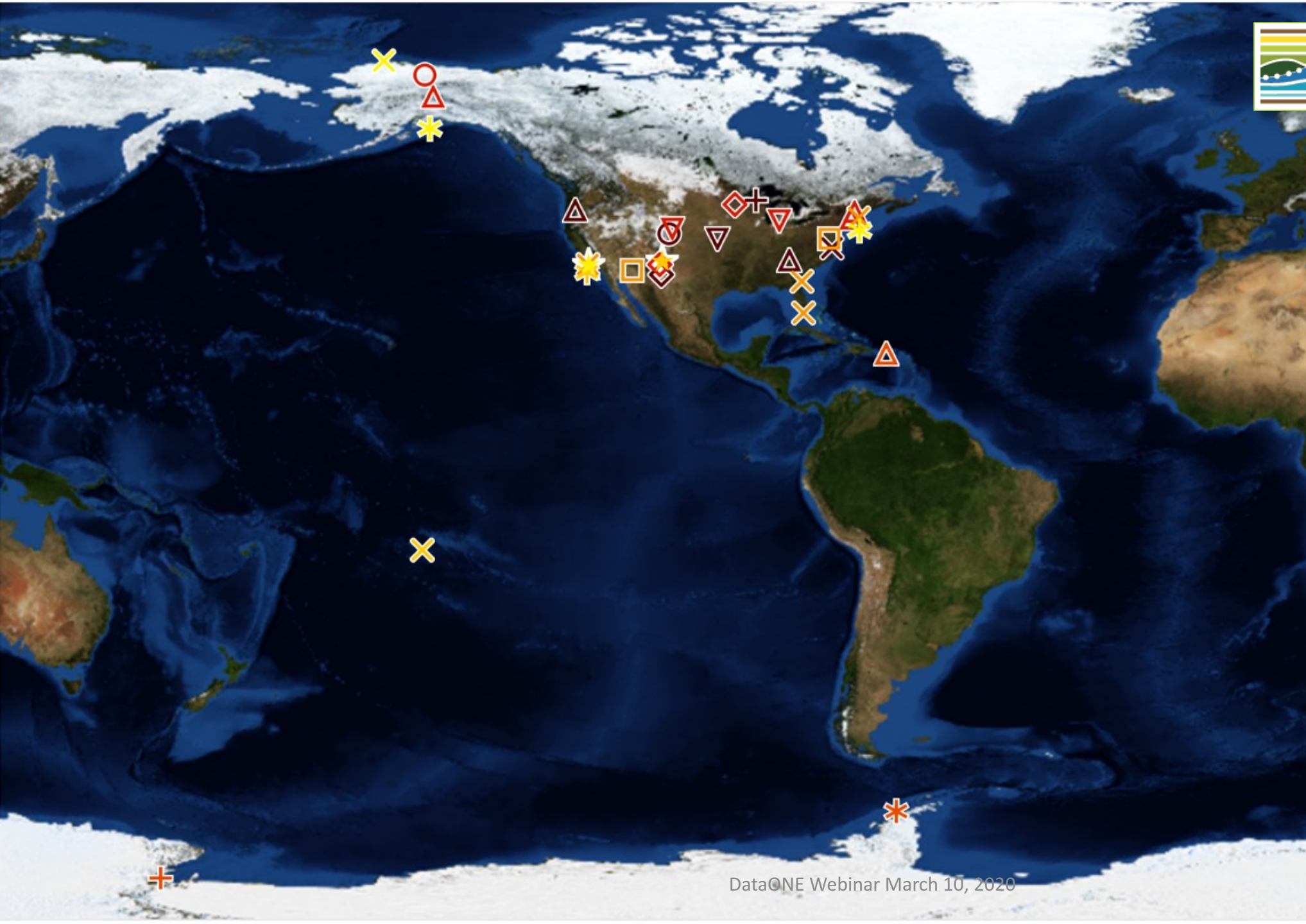
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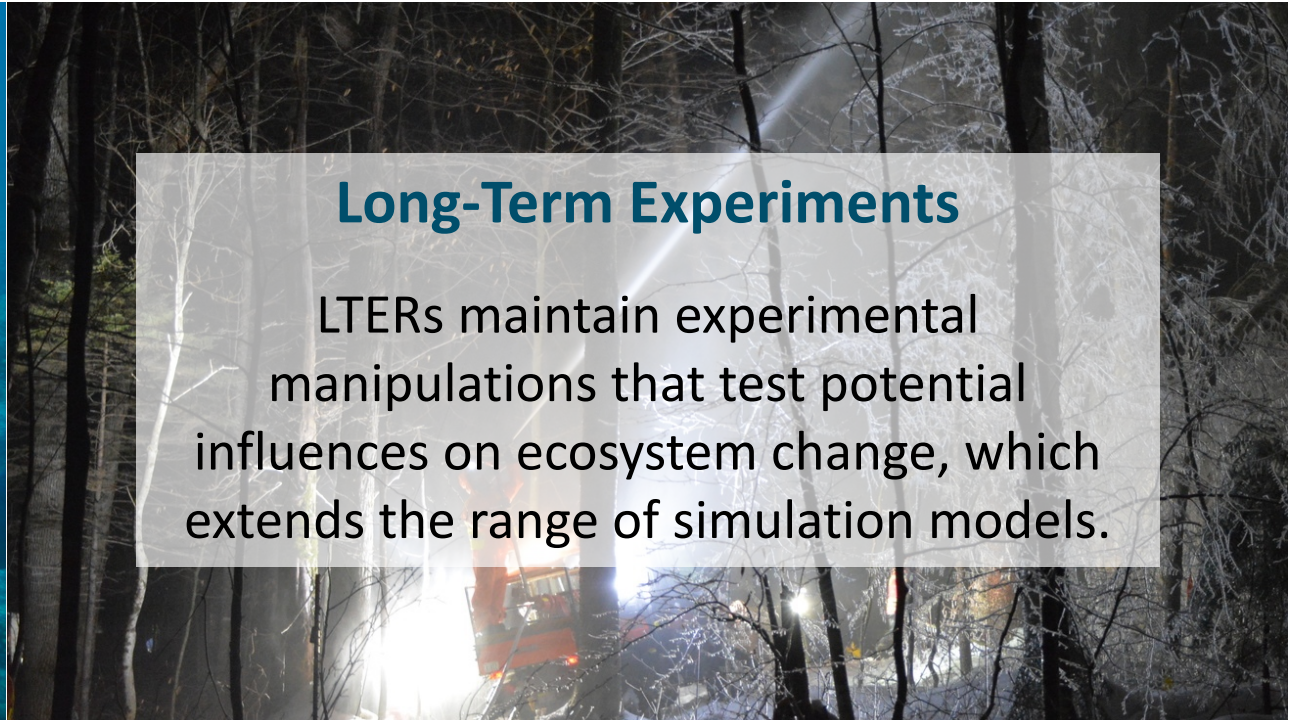
- Ecosystem Type**
- ★ Administrative
 - × Coastal
 - △ Forest
 - + Freshwater
 - ▽ Grassland-Agriculture
 - * Marine
 - ◇ Mixed-Landscape
 - Tundra
 - Urban

- Funding Cycles**
- 1
 - 3
 - 4
 - 5
 - 6
 - 7



Long-Term Observations

Each site maintains long-term records of key parameters for that ecosystem, providing critical context for shorter-term studies and cross-system comparisons.



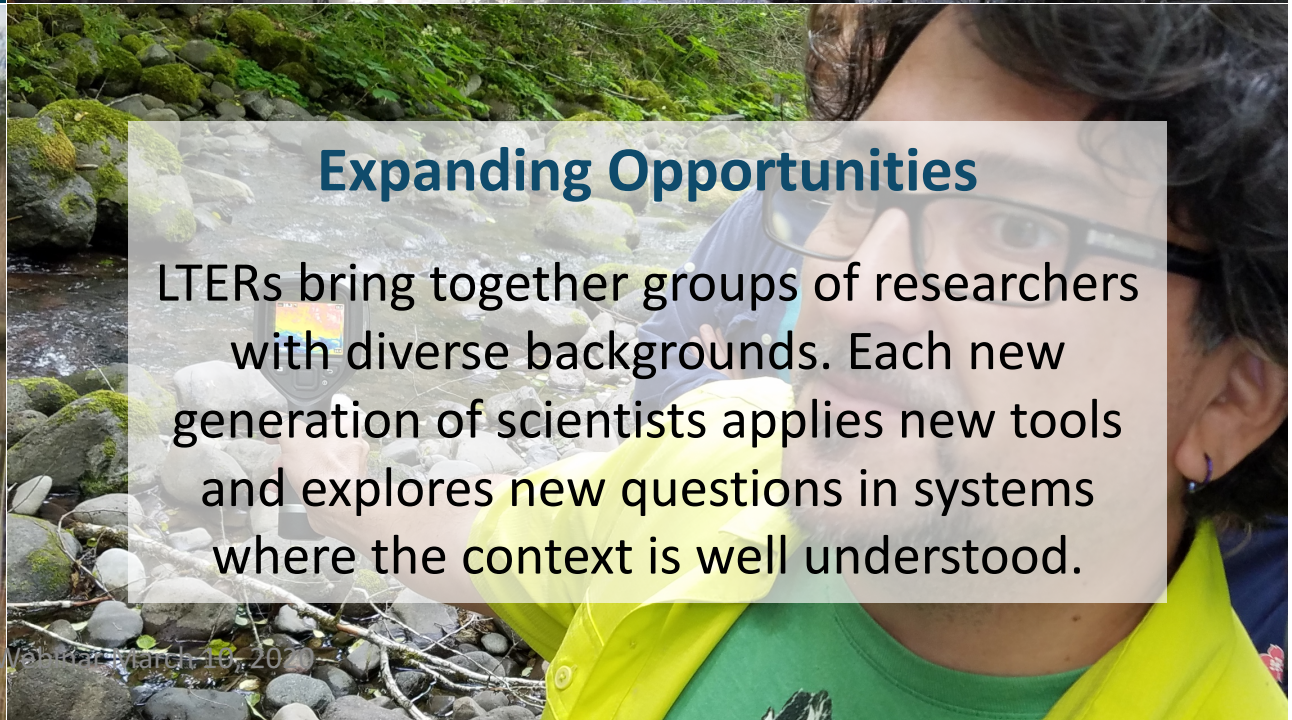
Long-Term Experiments

LTERs maintain experimental manipulations that test potential influences on ecosystem change, which extends the range of simulation models.



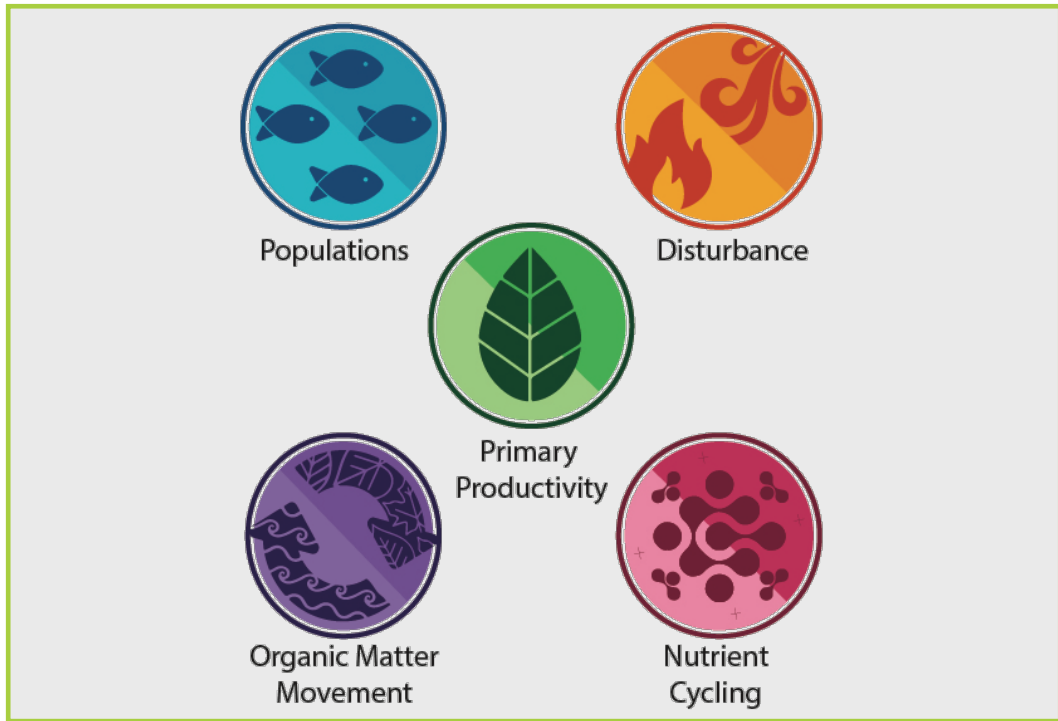
Long-Term Relationships

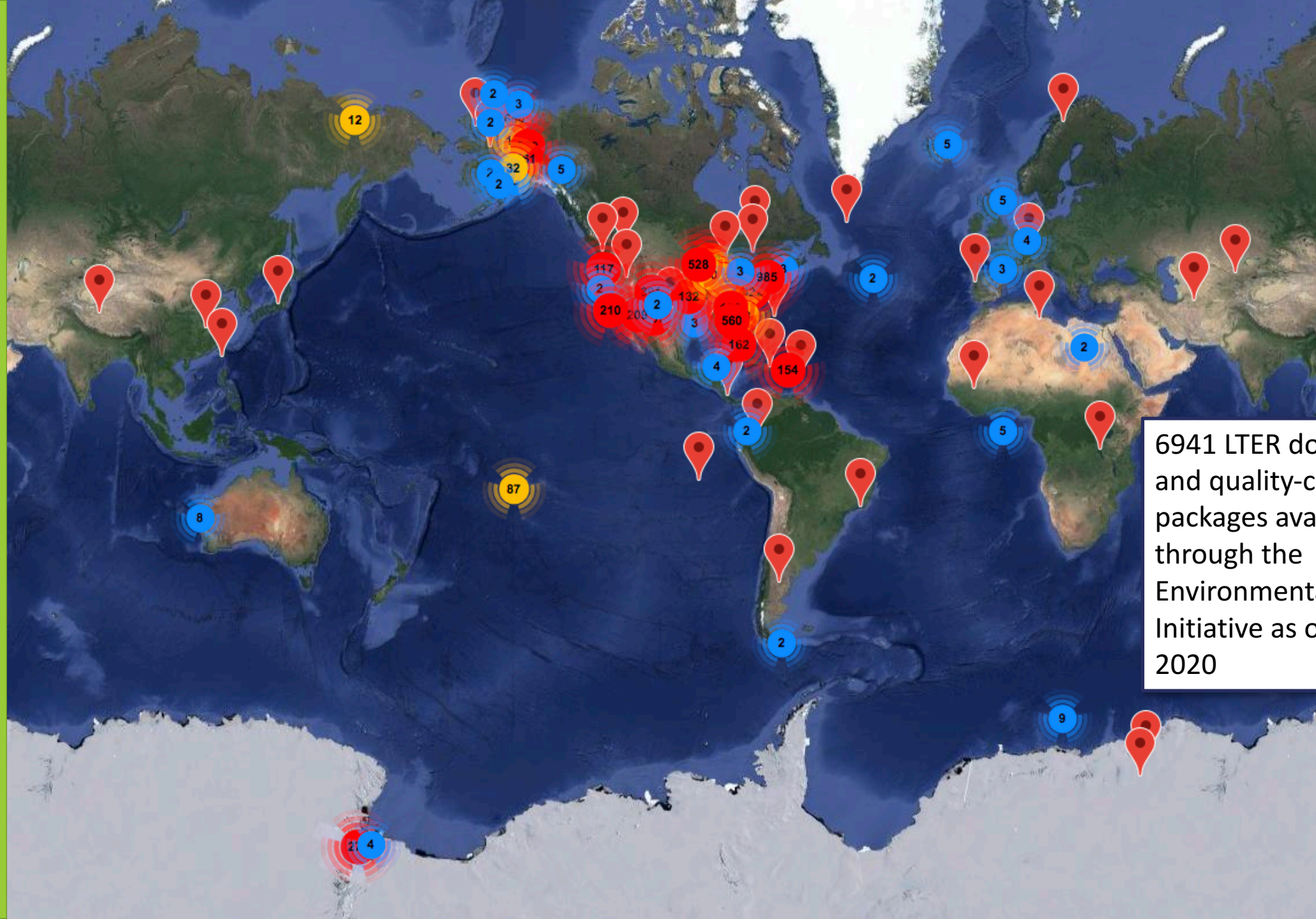
LTER sites build trusting relationships with resource managers, educators, and landowners in their regions.



Expanding Opportunities

LTERs bring together groups of researchers with diverse backgrounds. Each new generation of scientists applies new tools and explores new questions in systems where the context is well understood.





6941 LTER documented and quality-checked data packages available through the Environmental Data Initiative as of March 9, 2020

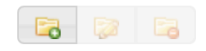


LTER Background

Upgrade Storage

Search Title, Creator, Year

Home > Groups > LTER Network > Library



- Library
- .LTER Network Office (UCSB)
- .LTER Network Office (UNM)
- Andrews Forest LTER
- Arctic LTER
- Baltimore Ecosystem Study LTER
- Beaufort Lagoon Ecosystem LTER
- Bonanza Creek LTER
- California Current LTER
- Cedar Creek LTER
- Central Arizona-Phoenix LTER
- Coweeta LTER
- Florida Coastal Everglades LTER
- Georgia Coastal Ecosystems LTER
- Harvard Forest LTER
- Hubbard Brook LTER

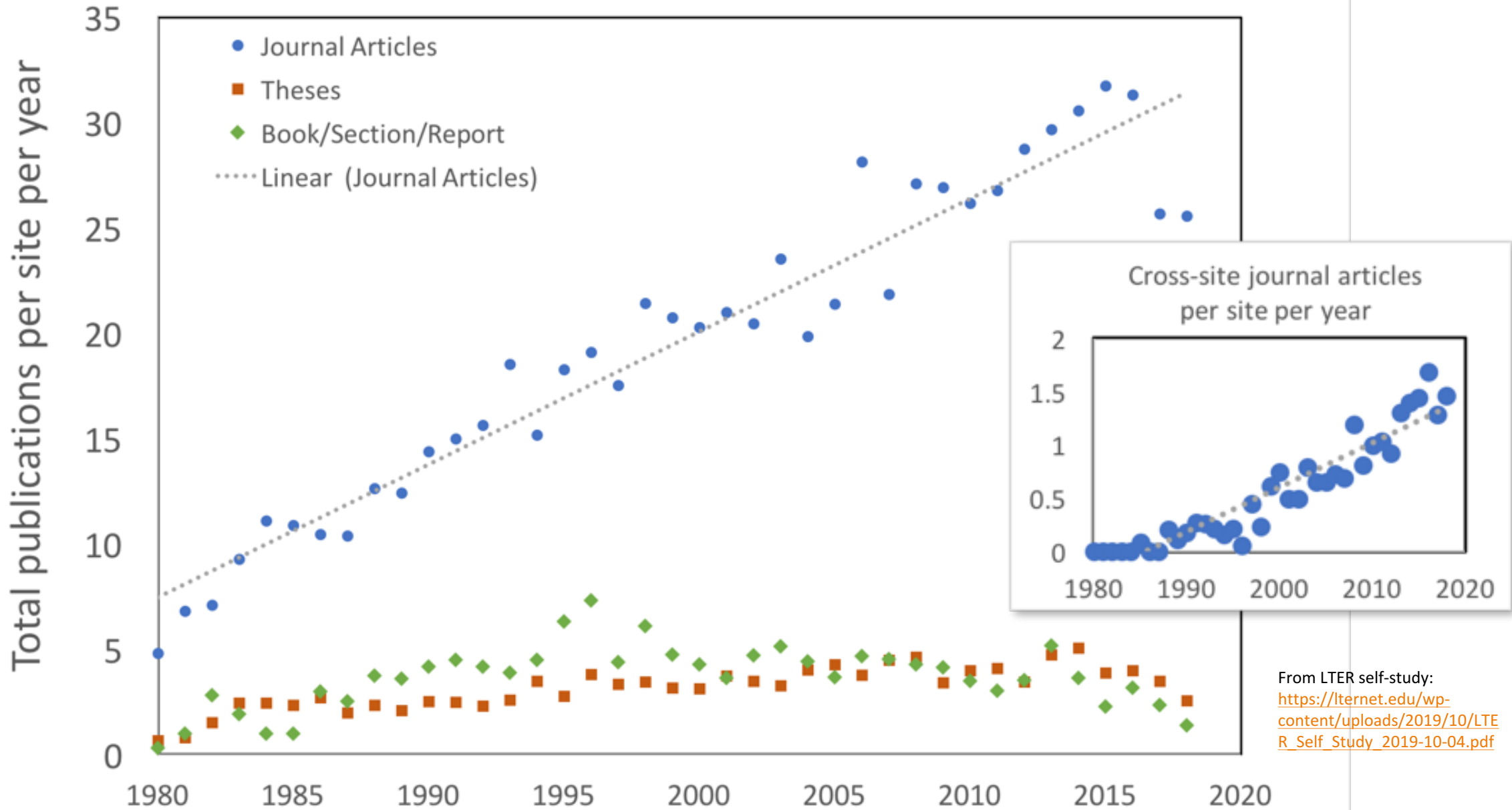
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<input type="checkbox"/>	Coupling telemetry and stable isotopes techniques to unravel ...	Eggenberger et al.	Journal Article	OCT 2019	Fisheries Research
<input type="checkbox"/>	Assessing the impact of	Journal Article	...	International Journal of Remote Sensing
<input type="checkbox"/>	Direct observation of permafrost degradation and ...	Plaza et al.	Journal Article	AUG 2019	Nature Geoscience
<input type="checkbox"/>	Extreme weather events and transmission losses in arid stream...	Schreiner-...	Journal Article	AUG 2019	Environmental Research Letters
<input type="checkbox"/>	Impacts of climate and insect herbivory on productivity and ...	McGraw et al.	Journal Article	AUG 2019	Environmental Research Letters
<input type="checkbox"/>	Range expansion in an introduced social parasite-host specie...	Boyd et al.	Journal Article	AUG 2019	Biological Invasions
<input type="checkbox"/>	Parental environments alter DNA methylation in offspring of ...	Helms et al.	Journal Article	AUG 2019	Journal of Experimental Marine Biology and Ecology
<input type="checkbox"/>	Spatial patterns of extracellular enzymes: Combining X-ray c...	Strader et al.	Journal Article	AUG 2019	Soil Biology & Biochemistry
<input type="checkbox"/>	Soil microbial, nematode, and enzymatic responses to elevate...	Kravchenko et al.	Journal Article	AUG 2019	Soil Biology & Biochemistry

<https://www.zotero.org/groups/2055673/lter-network/items>



Thank you to the many current and former LTER information managers and administrators who have maintained the database of products over the past 40 years.

LTER Publications per site per year (1980-2018)



From LTER self-study:
https://lternet.edu/wp-content/uploads/2019/10/LTER_Self_Study_2019-10-04.pdf

LTER Network Background

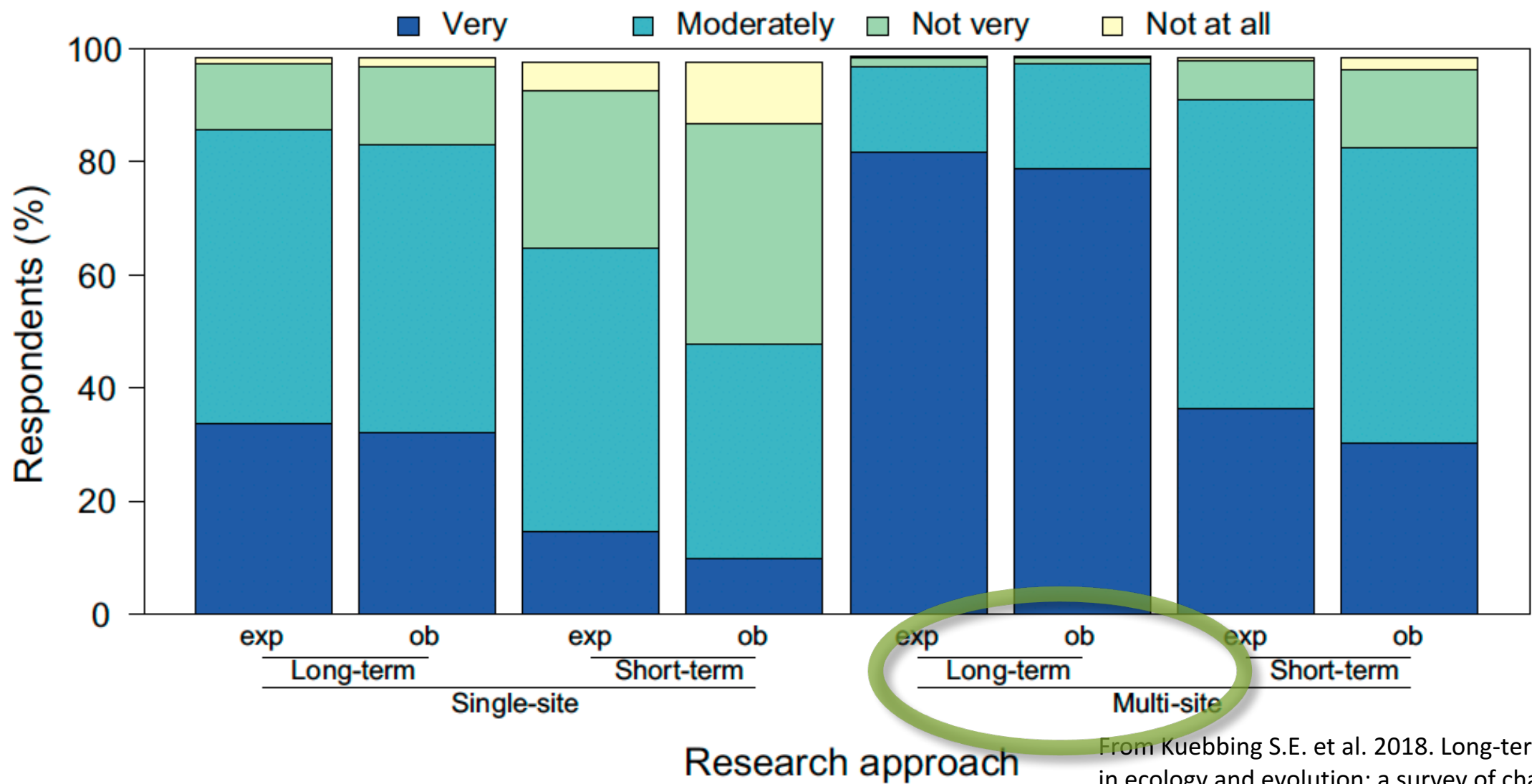
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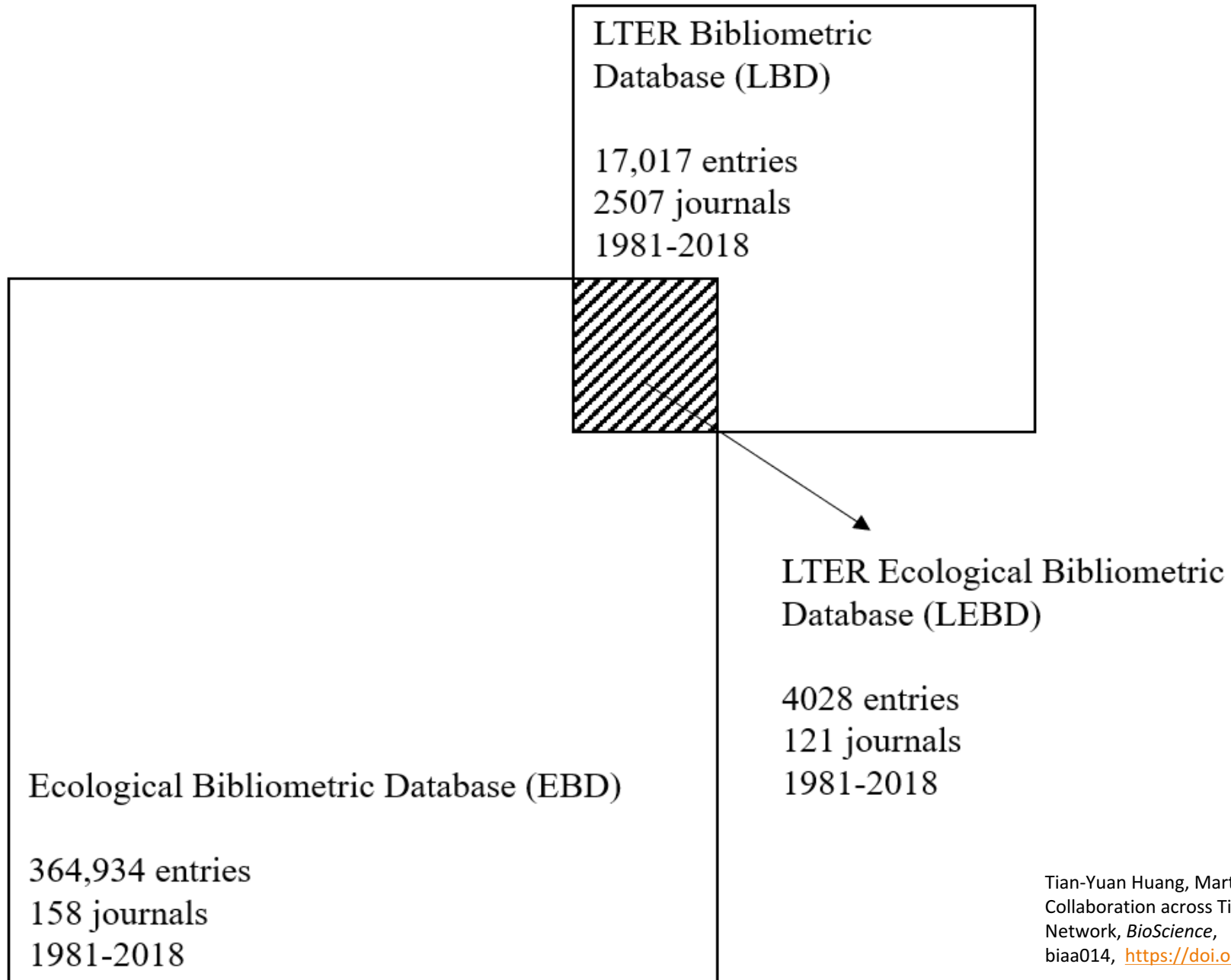
Cross-site Collaboration

- Site Age
- Ecosystem type
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To what extent are the following research approaches important to developing general theories in ecology and evolutionary biology?

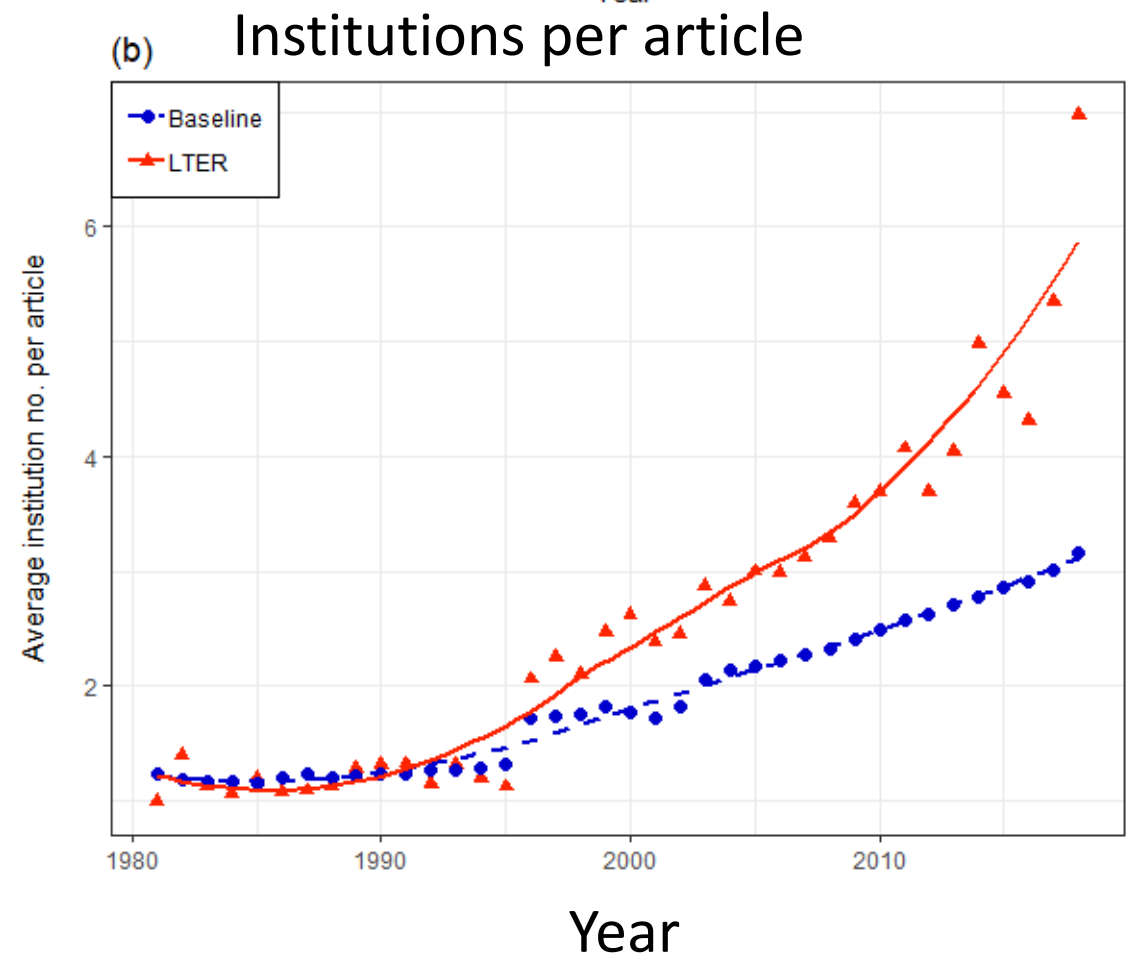
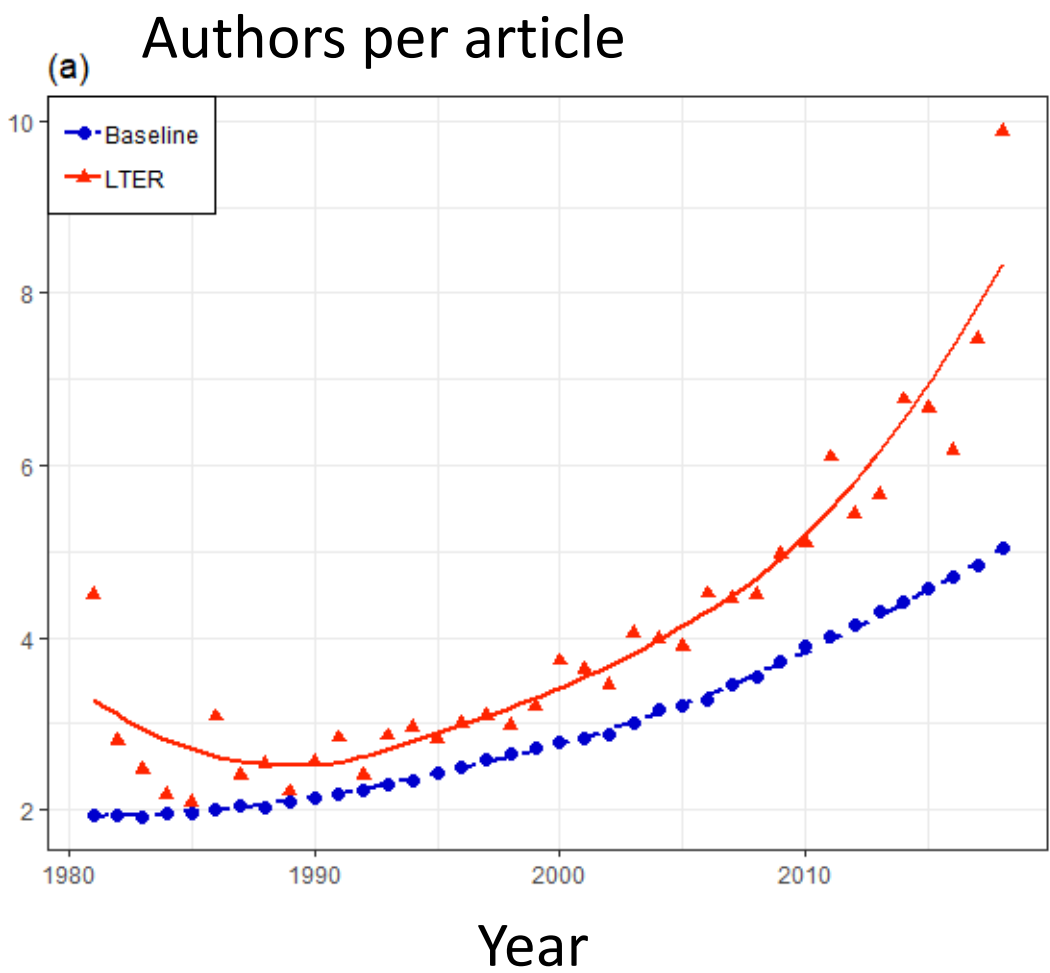


From Kuebbing S.E. et al. 2018. Long-term research in ecology and evolution: a survey of challenges and opportunities. Ecological Monographs

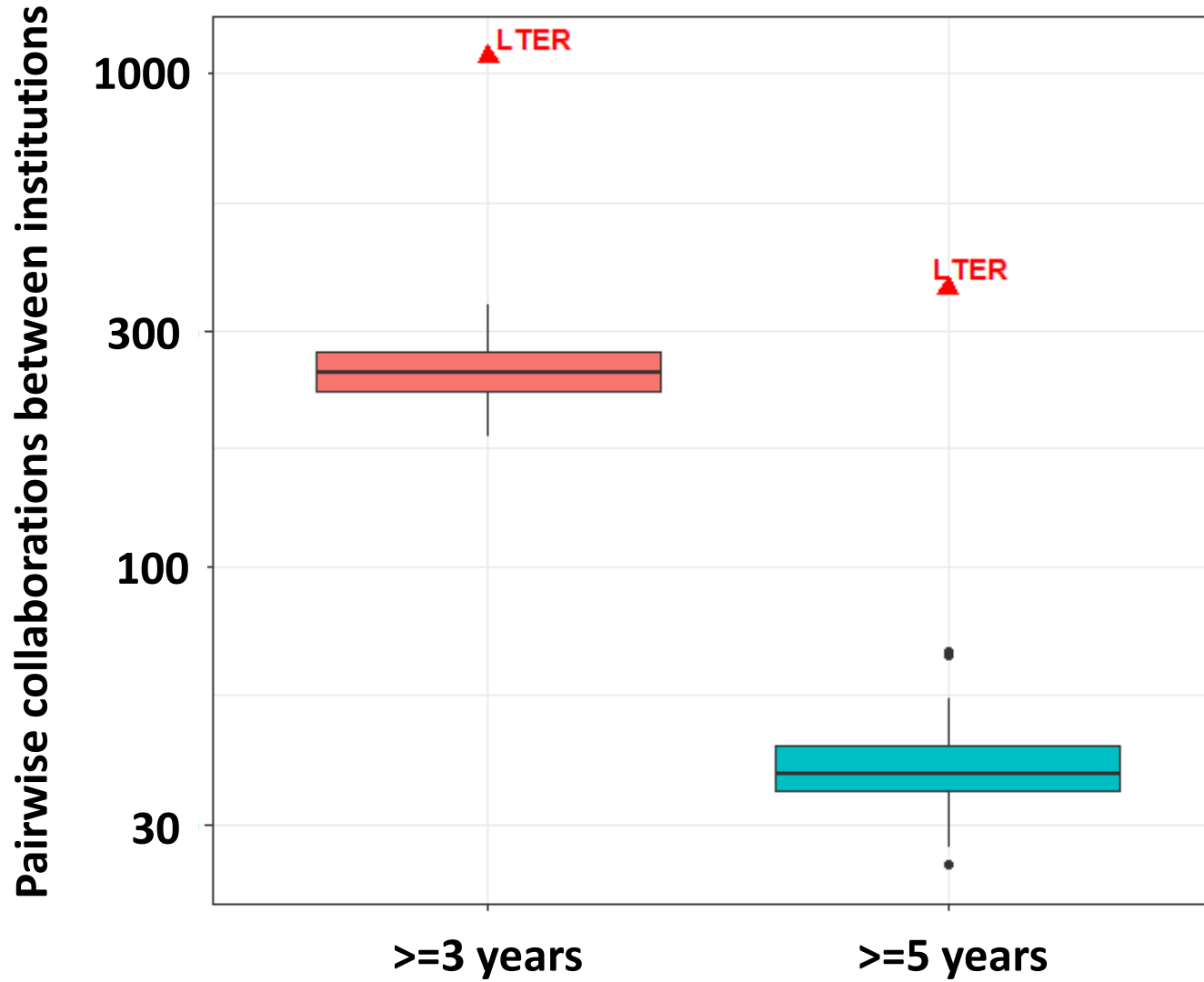


Tian-Yuan Huang, Martha R Downs, Jun Ma, Bin Zhao,
Collaboration across Time and Space in the LTER
Network, *BioScience*,
biaa014, <https://doi.org/10.1093/biosci/biaa014>

Authors and Institutions per Publication

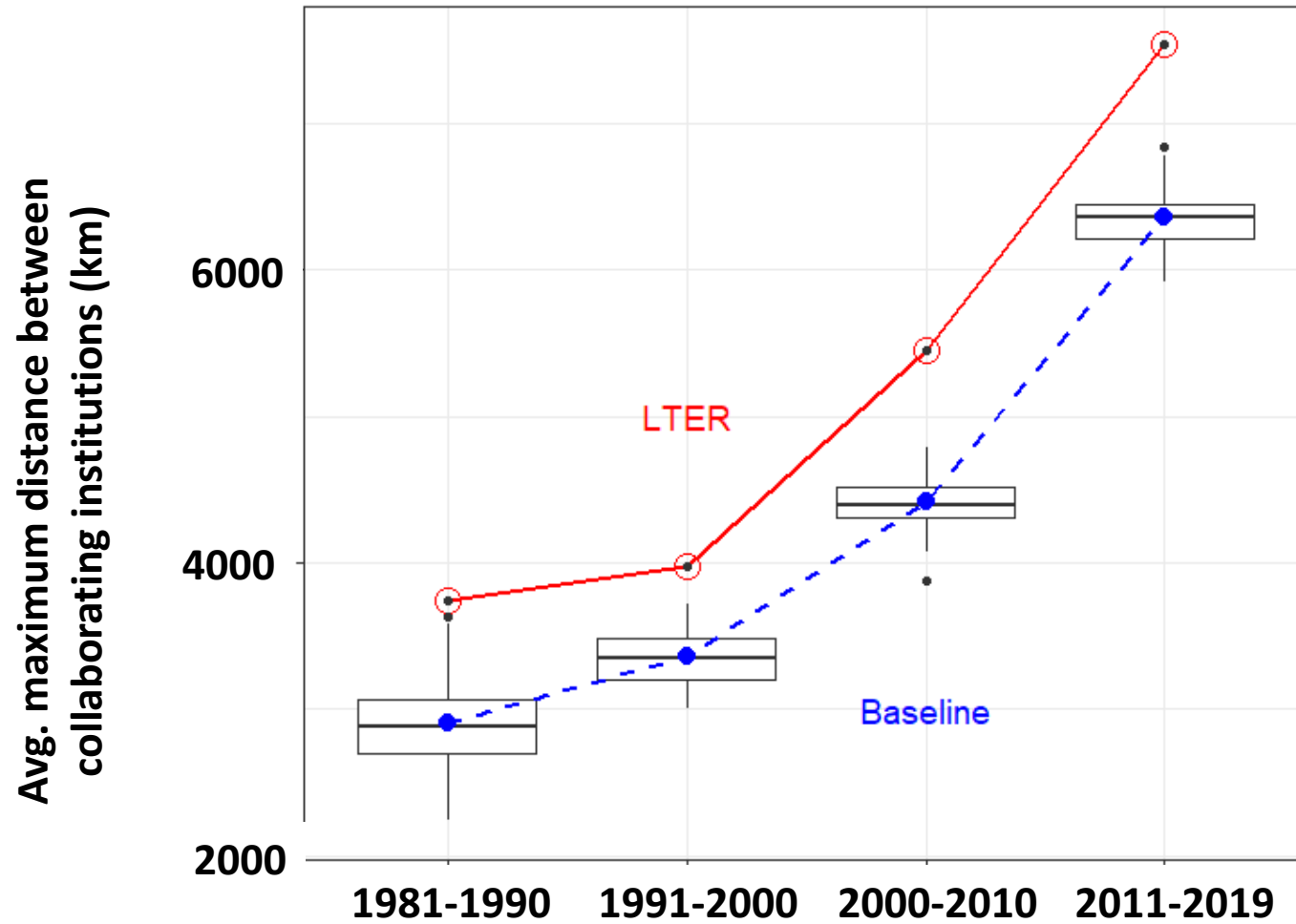


Duration



Tian-Yuan Huang, Martha R Downs, Jun Ma, Bin Zhao,
Collaboration across Time and Space in the LTER
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Distance



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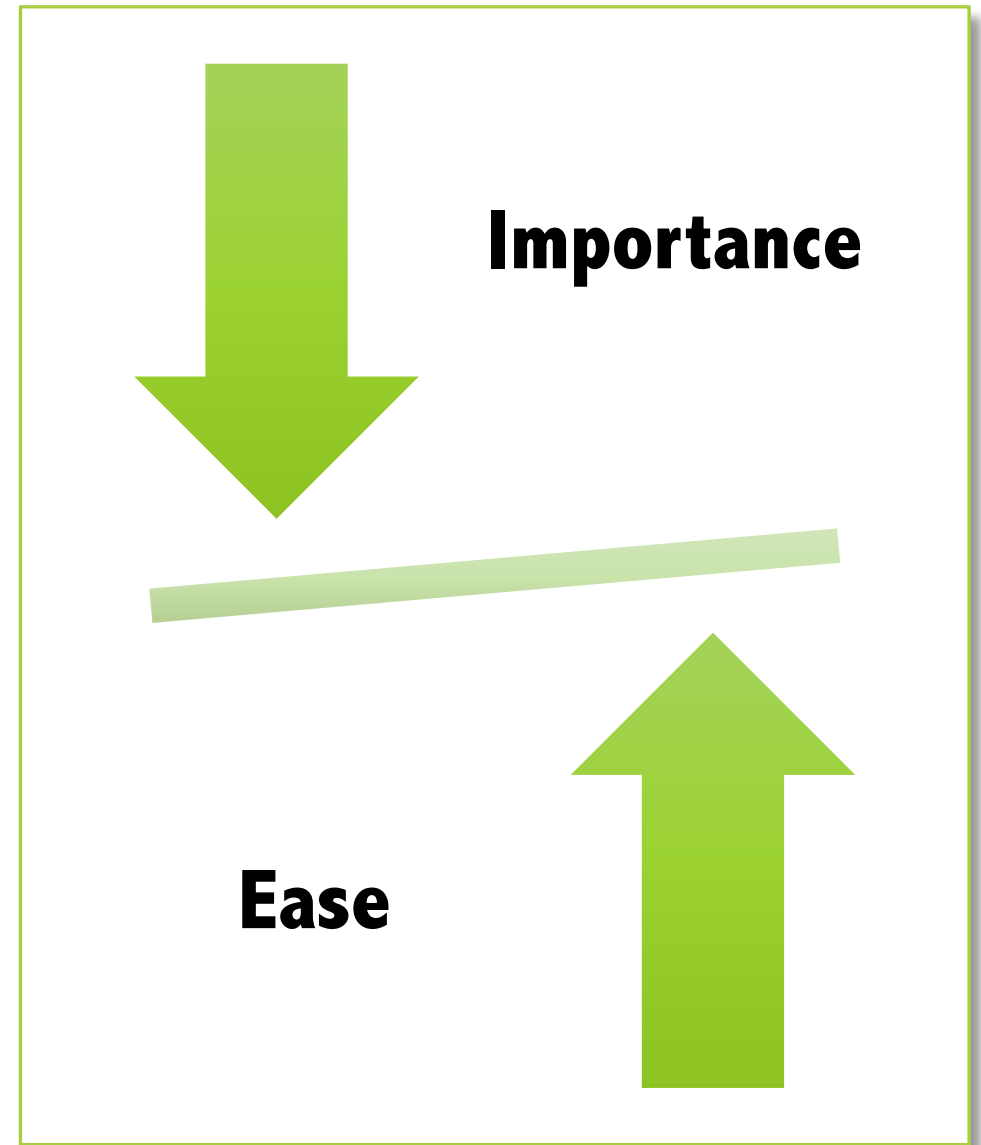
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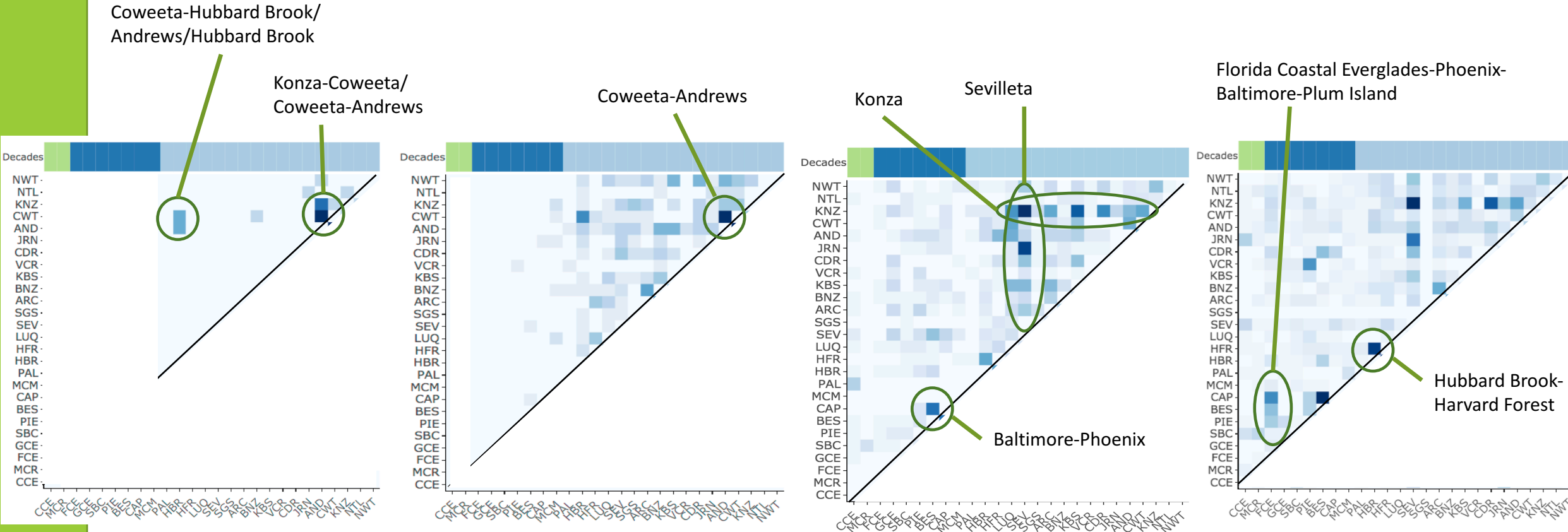
Why THIS collaboration?

1. Physical proximity (within institution, within site)
2. Existing personal relationships (mentorships, friendships, career moves)
3. Ecological comparisons (similar systems or broader inference space)
4. Deliberate incorporation of needed skills or perspectives (modeling, social science, genomics, management perspective, etc.)





Pairwise Collaboration Count by Site Age



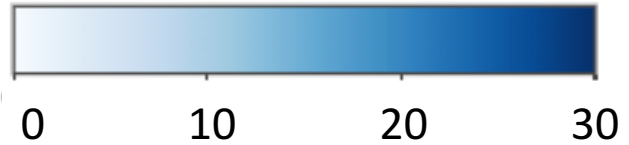
1981-1990

1991-2000

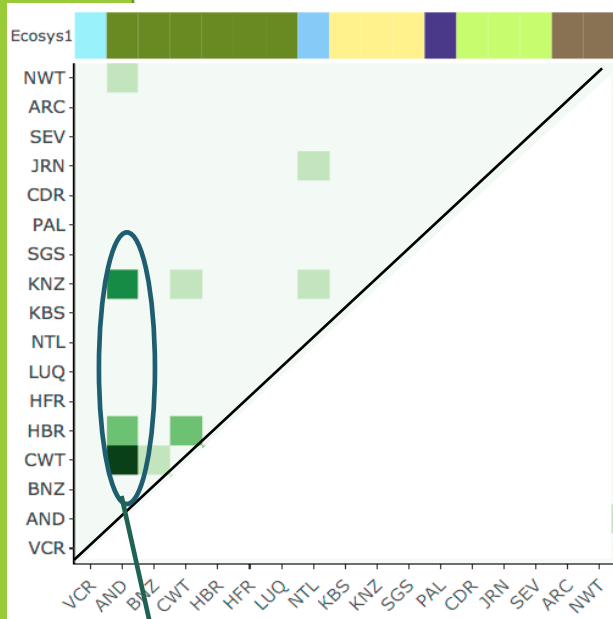
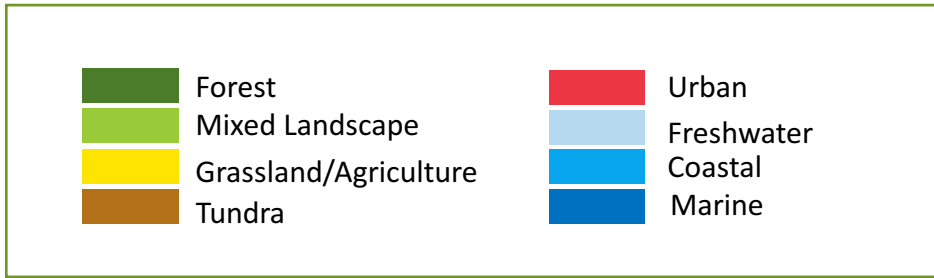
2001-2010

2011-2019

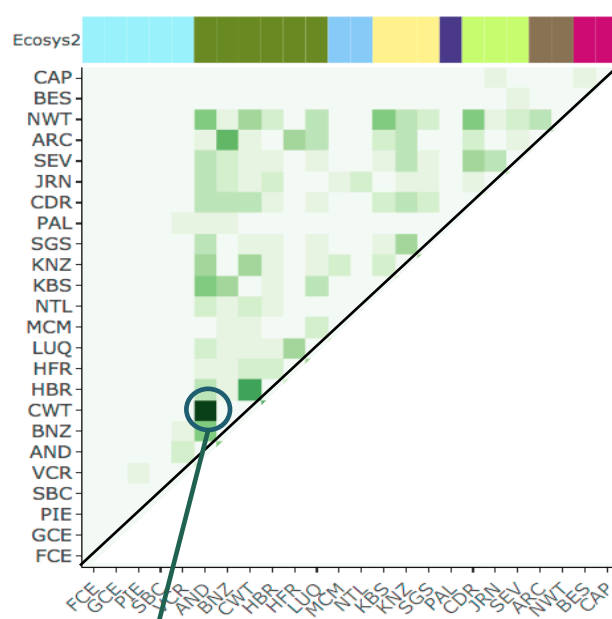
Unpublished analysis: You Cheng, Marty Downs, Julien Brun



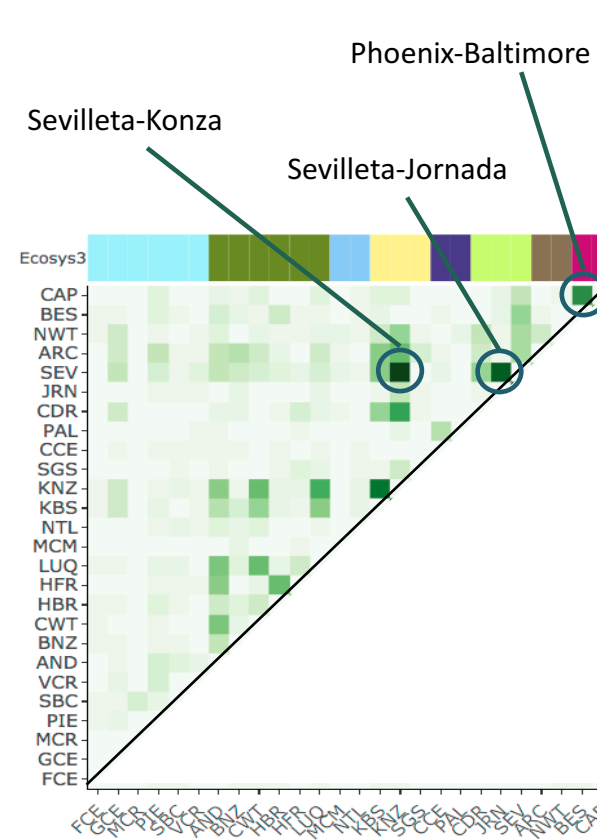
Pairwise Collaboration Count by Ecosystem Type



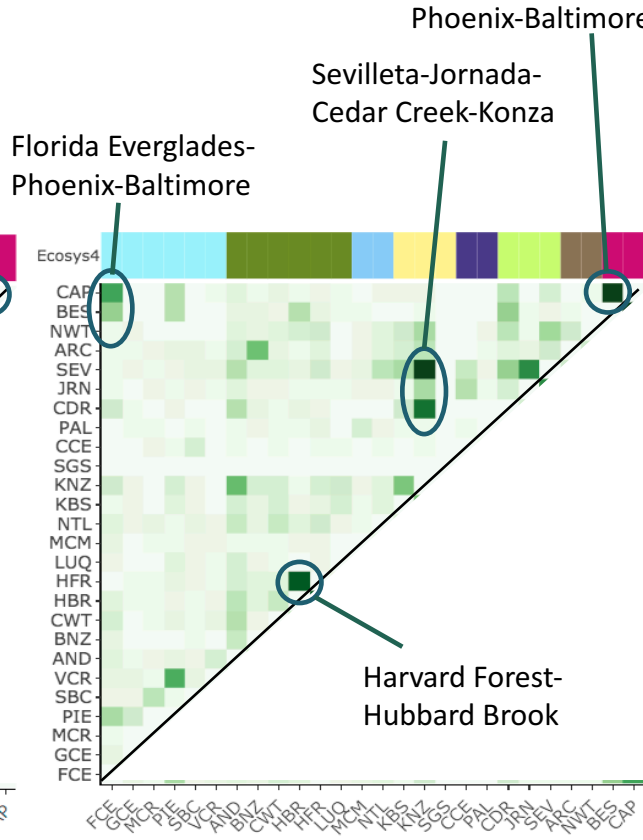
1981-1990
Andrews-Coweeta/Hubbard Brook/Konza



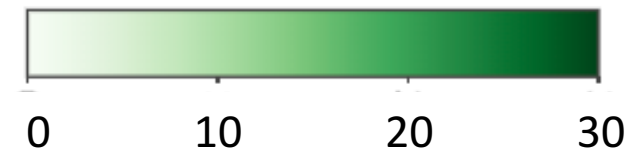
1991-2000
Andrews-Coweeta

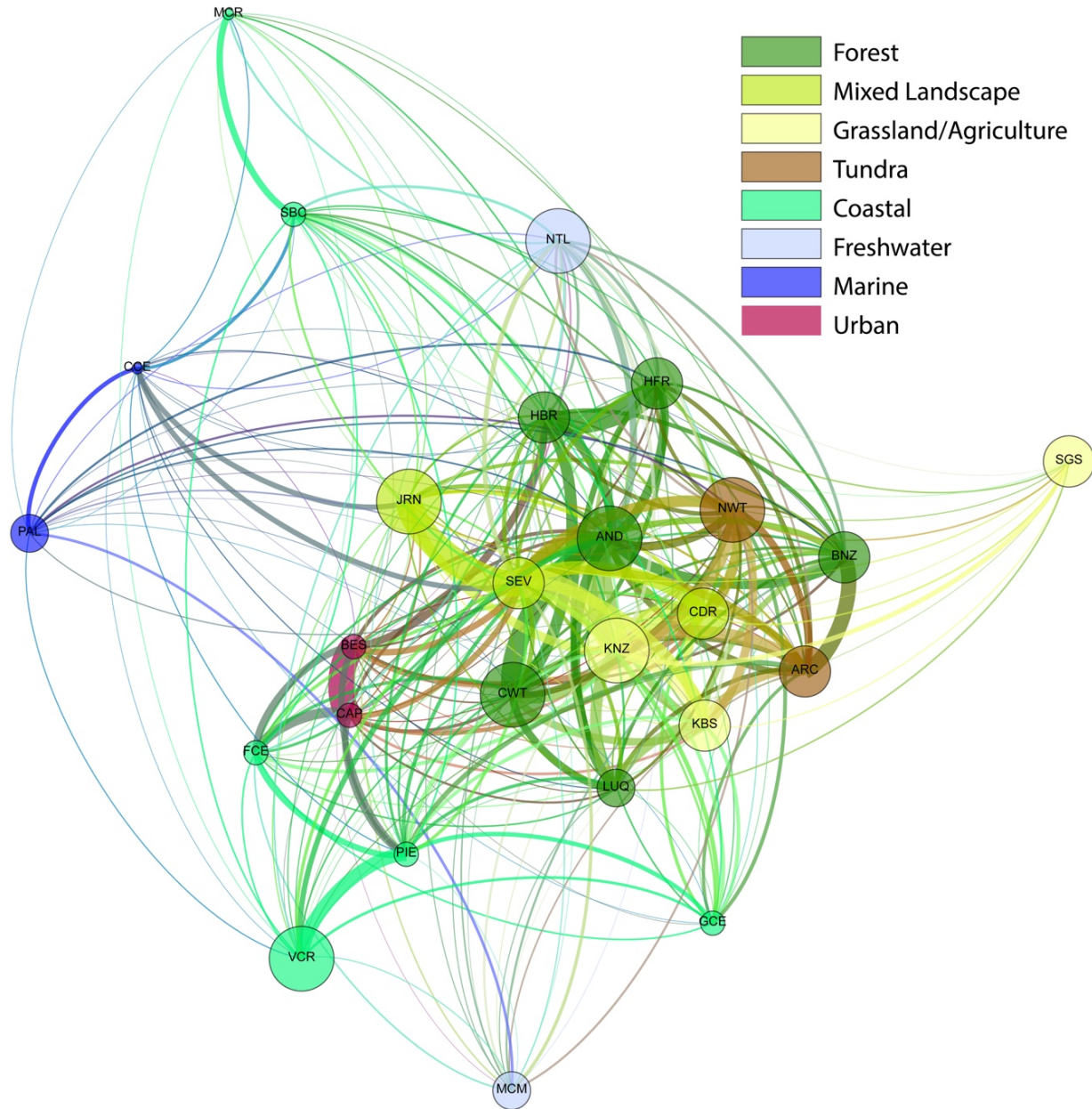


2001-2010



2011-2019





Force matrix algorithm in Gephi

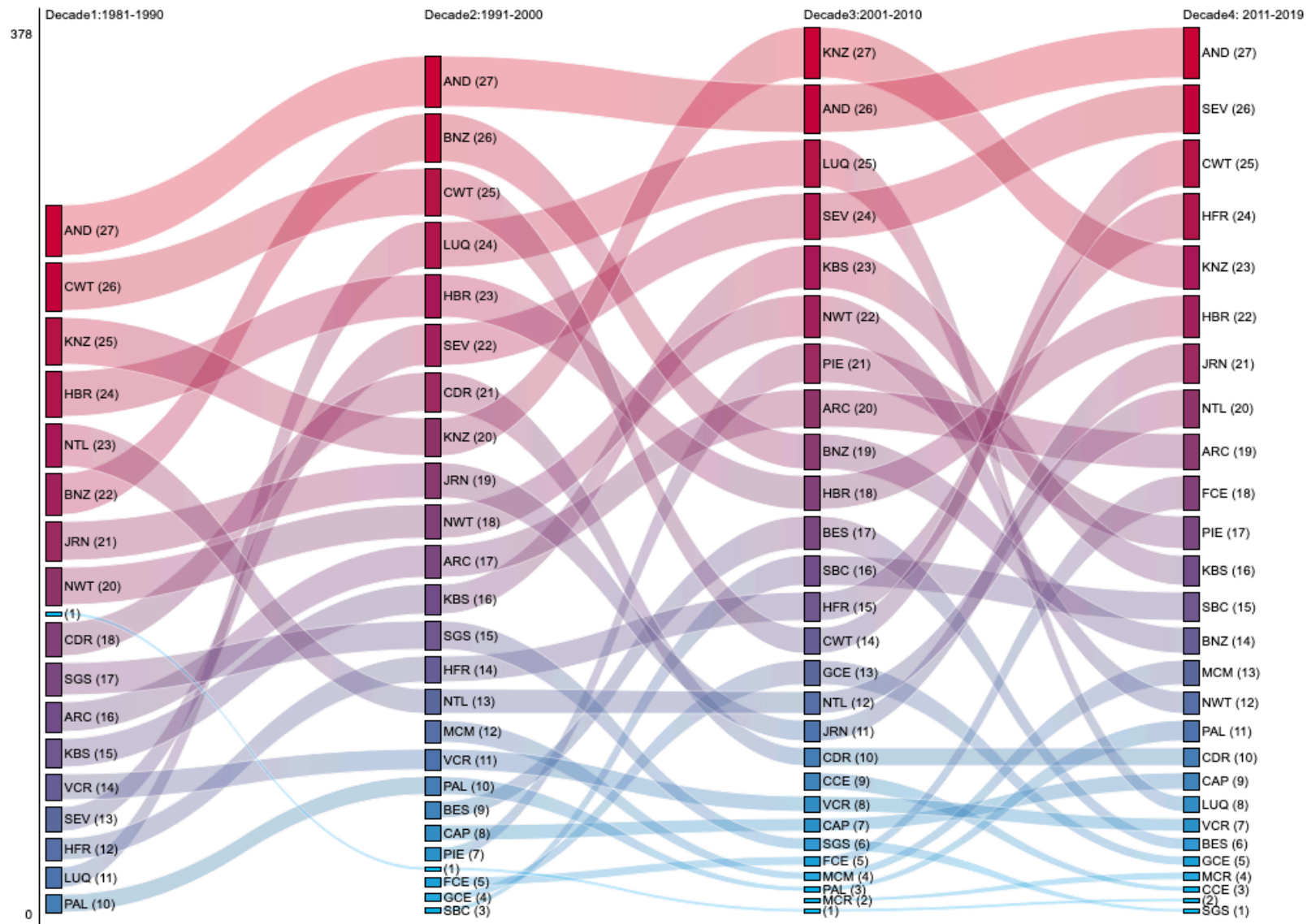
Node size: site age

Node color: ecosystem type

Edge thickness: collaboration count

Position: network centrality

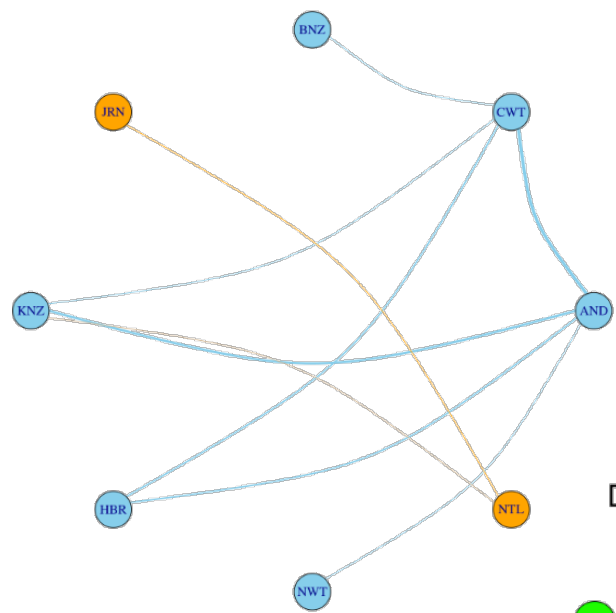
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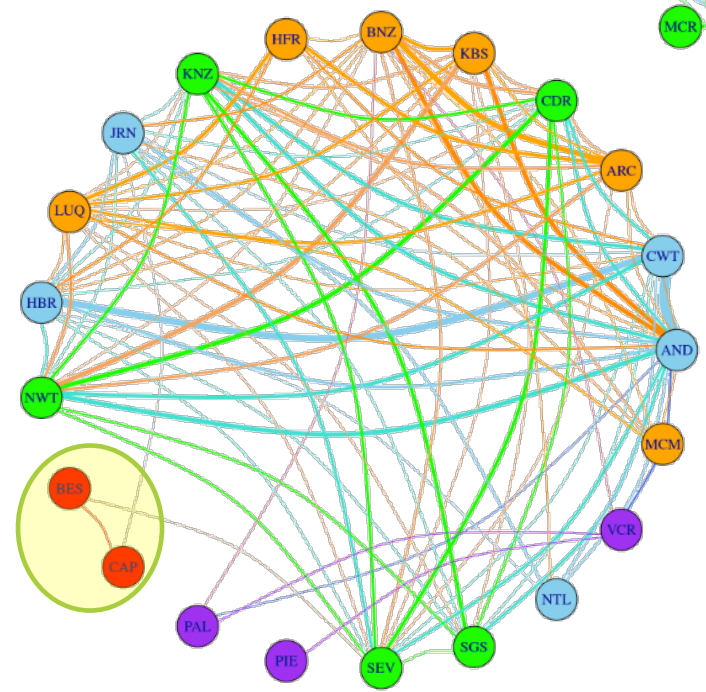
Cross-Site Collaboration

- Rank by decade
- Based on degree centrality metric

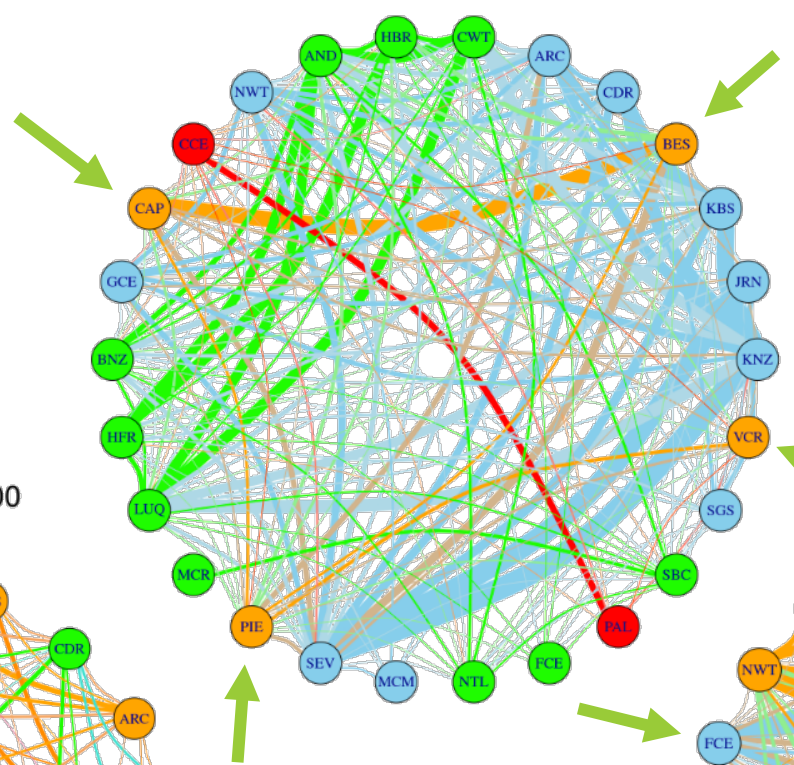
Decade1: 1981 - 1990



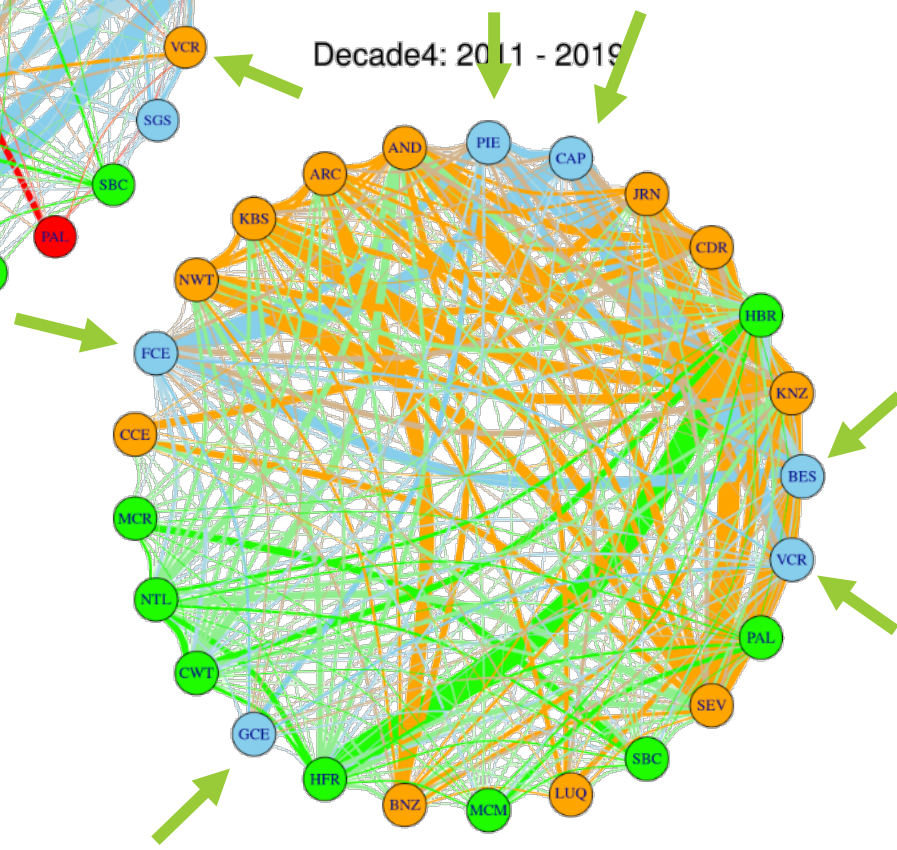
Decade2: 1991 - 2000

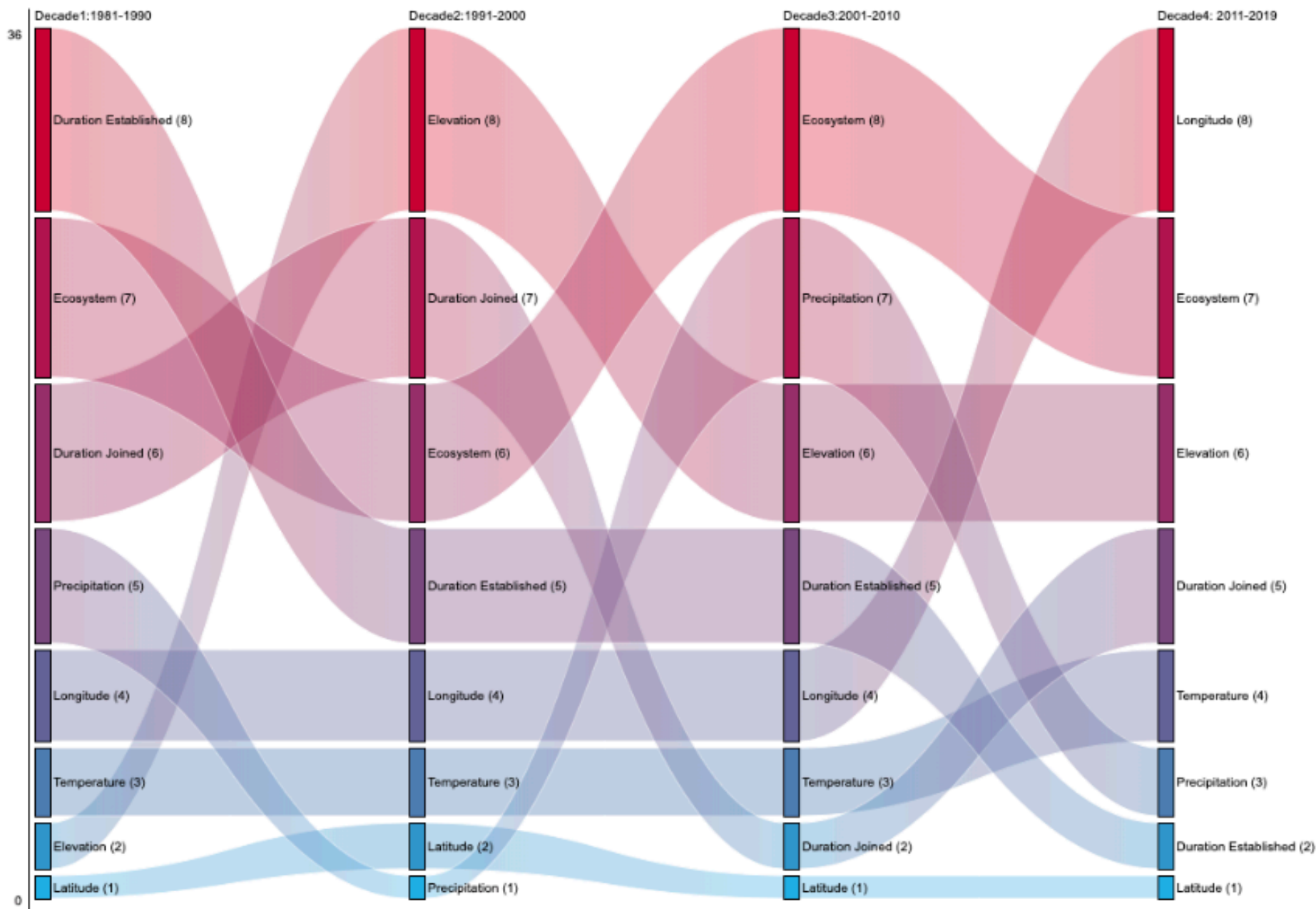


Decade3: 2001 - 2010



Decade4: 2011 - 2019





Factor Importance Ranking Across 4 Decades
DataONE Webinar March 10, 2020

Conclusions

Collaboration in LTER-related papers

- Individuals: about 1.5 x the field average for ecology
- Institutions: rapid acceleration after 1995 to more than twice the field average
- Duration: ~3 times as many collaborations lasting 3 or more years and 10 times as many collaborations lasting 5 or more years
- Distance: LTER collaborations involve slightly greater distances than the field in general, throughout the period of record

Cross-site Collaboration

- Intersite collaborations are most frequent among sites of the same ecosystem types funded at about the same time
- Interests at sites evolve over time and the network helps to rapidly engage other sites with similar interests.
- Factors related to cohesion: Importance of site duration plateaus after ~10 years. Other factors (elevation, precipitation) vary over time.

Thanks

Questions?

